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FOR CHARGEMAN LDCE

ENGLISH VERSION

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SYLLABUS FOR GENERAL PAPER IN ENGINEERING (CM)

UNITS- Introduction, Definition, Classification of Units.

GENERAL SIMPLIFICATIONS- Introduction, Fractions, Decimals, Divisions, and Multiplications of Fractions.

SQUARE ROOTS- Square and Square roots, Symbol of root, Method of finding out the Square roots.

GRAPH- Definition, Rules for drawing graph, Drawing and reading of simple graphs, Graph of simple equations and compound equations.

RATIO AND PROPORTION- Ratio, Proportion.

PERCENTAGE

ALGEBRA- Introduction, Addition and Subtraction, Multiplication and Division. Algebraic formulae, Proofs, Factorization, Equations.

MENSURATION- Introduction, Rectangle, Square, Parallelogram, Rhombus, Trapezium, Triangles, Hexagon, Circle, Sector, Segment of a Circle, Ellipse, Length of Belts, Area of irregular surfaces, Area of four walls, Finding out volume of solids, frustum of cone and pyramid.

TRIGONOMETRY- Definition, Trigonometrical formulae, Measurement of angles, Use of trigonometrical tables and logarithmic trigonometric tables. Trigonometric values of certain degrees, Area of triangle, line bar, Angle of elevation and depression, Taper turning Calculations, Solution of Triangles using Sine Rule and Cosine Rule.

METALS- Properties of metal, Types of metals, Difference between ferrous and non-ferrous metals, Ferrous metals, Classification of Iron, Pig Iron, Cast Iron, Wrought Iron, Steel. Types of Steel, difference between Cast Iron and Steel, Alloy Steel, Type of Alloy steel, Non-ferrous metals, Melting point and Weight. Non-ferrous Alloys.

HEAT TREATMENT- Function of heat treatment, Critical temperature, Annealing, Normalizing, Hardening. Tempering and Case Hardening.

DENSITY AND RELATIVE DENSITY- Mass, Unit of mass, Weight, Difference between mass and weight of substance, Density, Unit of Density, Relative Density.

FORCE- Newton's laws of motion, Unit of force, To find out resultant force, Space and vector diagrams, Representation of force, Parallel forces, Couple, Parallelogram law of force, conditions of equilibrium, Kinds of equilibrium, some examples of equilibrium in daily life, Triangle of force, Converse of triangle of forces, Lami's theorem, Jib Crane.

MOMENT AND LEVER- Moments, Unit, Arm of Couple and Moment of Couple, Lever.

SIMPLE MACHINES- Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Output and Input, Efficiency, Velocity Ratio and Mechanical Advantage, Pulley Block, Incline Plane, Simple Wheel and axle, Simple Screw Jack.

WORK POWER AND ENERGY - Work, Units of work, Power, Units of Power, Horse Power of Engines, Mechanical Efficiency, Energy. Uses of Energy, Potential and Kinetic Energy, Examples of Potential and Kinetic Energies. Transmission of power by a belt pulley drive.

FRICTION- Definition, Advantages and Disadvantages of Friction. Normal Reaction, Limiting friction, Laws of Limiting friction, Coefficient of friction, Angle of friction, Inclined plane, Force of friction, when the force is horizontal, Force of reaction when the force is inclined at an angle, with the horizontal.

SIMPLE STRESSES AND STRAINS- Introduction, Stress and Strain, Different types of stresses. Hooke's law, Young's modulus or Modulus of Elasticity. Yield point, Ultimate Stress and working stress, Factor of Safety, Stress-Strain Graph, modulus of Rigidity, Poisson's Ratio, Bulk modulus, Relationship between three modulus for a given material.

VELOCITY AND SPEED - Rest and motion, vector quantity, Scaler quantity, Speed, Velocity, Difference between velocity and speed, Acceleration, Equation of motion, Motion under the force of gravity.

HEAT- Heat, Unit of heat, Temperature, Difference between Heat and Temperature, Boiling point,

Melting point, Scale of Temperature, Specific heat, Thermal capacity, Water equivalent of heat, Inter change of heat, Calorimeter, Latent heat of fusion, Latent heat of vapour, Transmission of heat, Thermos flask, Pyrometer, Thermocouple, Thermo electric Pyrometer, Coefficient of linear expansion, Indicated Thermal Efficiency, Brake Thermal Efficiency.

ELECTRICITY - Introduction, Use of electricity, Molecule, Atom, Particles in Atom, How electricity is produced, Electric Current, Ammeter, Electromotive Force, Electric Voltage, Potential difference, Resistance, Conductor, Insulator, Switch, Fuse, Circuit, Ohm's law, Series and Parallel connections, Power, Horse Power, Energy, Unit of Electrical Energy.

PRESSURE- Atmosphere, Atmospheric pressure, Pressure, Unit, Pressure at a depth in a liquid, Absolute pressure, Gauge pressure, and vacuum pressure, How to measure pressures.

CENTRE OF GRAVITY- Introduction, Definition, Centroid, Methods of finding out Centre of gravity of figures, Centre of gravity of certain geometrical configurations, Centre of gravity Calculations.

THIN CYLINDRICAL SHELLS- Thin cylindrical shells, Assumptions, Circumstantial or Hoop Stresses, Longitudinal or Axial Stresses, Relationship between Stresses, Built up Cylindrical shells.

References

1. Work Shop Calculation & Science by Kapil Dev Asian Publishers, Delhi.
2. Basic Workshop Calculation and Science by R P Kumaer, R Dev, K C Narang New heights, Karol Bagh, New Delhi-110005

General simplifications

1. Solving Linear Equations

Problem: Solve for x :

$$3x+5=11 \quad 3x+5-5=11-5$$

Solution:

- Subtract 5 from both sides:
 $3x+5-5=11-5$
- Divide by 3:
 $x=2$

2. Solving for the Area of a Rectangle

Problem: Find the area of a rectangle with length 5 cm and width 8 cm.

Solution:

- Use the formula for area: $A = \text{length} \times \text{width}$
 $A = 5 \text{ cm} \times 8 \text{ cm} = 40 \text{ cm}^2$

3. Simplifying Expressions with Exponents

Problem: Simplify $3x^2 \cdot 2x^3 \cdot 2x^3$.

Solution:

- Multiply the coefficients: $3 \times 2 = 6$
- Add the exponents: $x^2 \cdot x^3 = x^{2+3} = x^5$
- Final simplified expression: $6x^5$

4. Calculating Speed

Problem: A car travels 100 km in 2 hours. What is its speed?

Solution:

- Use the formula for speed:
 $\text{Speed} = \frac{\text{Distance}}{\text{Time}}$
 $\text{Speed} = \frac{100 \text{ km}}{2 \text{ hours}} = 50 \text{ km/h}$

5. Solving for Force Using Newton's Second Law

Problem: A 5 kg object experiences an acceleration of 2 m/s^2 . What is the force acting on the object?

Solution:

- Use Newton's second law: $F = ma$
 $F = 5 \text{ kg} \times 2 \text{ m/s}^2 = 10 \text{ N}$

6. Simple Interest Calculation

Problem: Calculate the simple interest on a principal of \$500 at an interest rate of 5% for 3 years.

Solution:

- Use the formula for simple interest: $I = P \times r \times t$
 $I = 500 \times 0.05 \times 3 = 75$
- The interest earned is \$75.

7. Percentage Increase

Problem: The price of a product increases from \$40 to \$50. What is the percentage increase?

Solution:

- Use the percentage increase formula:
 $\text{Percentage Increase} = \frac{\text{New Value} - \text{Old Value}}{\text{Old Value}} \times 100$
 $\text{Percentage Increase} = \frac{50 - 40}{40} \times 100 = 25\%$

$$\frac{\text{New Value} - \text{Old Value}}{\text{Old Value}} \times 100 = 100$$

$$\text{Percentage Increase} = \frac{50 - 40}{40} \times 100 = \frac{10}{40} \times 100 = 25\%$$

8. Finding the Average

Problem: Find the average of the following numbers: 12, 15, 18, 22, and 30.

Solution:

- Add the numbers:
 $12 + 15 + 18 + 22 + 30 = 97$
- Divide by the number of values: $97 \div 5 = 19.4$
- The average is 19.4.

9. Volume of a Cylinder

Problem: Calculate the volume of a cylinder with a radius of 4 cm and a height of 10 cm.

Solution:

- Use the formula for the volume of a cylinder:
 $V = \pi r^2 h$
 $V = \pi \times 4^2 \times 10 = \pi \times 16 \times 10$
 $= 160\pi \approx 502.65 \text{ cm}^3$

10. Converting Units of Time

Problem: Convert 180 minutes into hours and minutes.

Solution:

- Divide 180 by 60 to convert to hours:
 $180 \div 60 = 3$ hours.

- The remainder is 0 minutes.
 Final result: 3 hours and 0 minutes.

fractions

1. Adding Fractions

Problem: $34 + 18\frac{3}{4} + \frac{1}{8}$

Solution:

- Find a common denominator (LCM of 4 and 8 is 8).
- Convert $34\frac{3}{4}$ to have a denominator of 8:
 $34 = 68\frac{6}{8}$
- Now, add the fractions:
 $68 + 18 = 86$
 $\frac{6}{8} + \frac{1}{8} = \frac{7}{8}$

2. Subtracting Fractions

Problem: $56 - 13\frac{5}{6} - \frac{1}{3}$

Solution:

- Find a common denominator (LCM of 6 and 3 is 6).
- Convert $13\frac{5}{6}$ to have a denominator of 6:
 $13 = 26\frac{2}{6}$
- Now, subtract the fractions:
 $56 - 26 = 30$
 $\frac{2}{6} - \frac{1}{6} = \frac{1}{6}$

3. Multiplying Fractions

Problem: $25 \times 34\frac{2}{5} \times \frac{3}{4}$

Solution:

- Multiply the numerators and denominators:

$$2 \times 35 \times 4 = 620 \frac{2 \times 3}{5 \times 4} = \frac{6}{20}.$$
- Simplify $620 \frac{6}{20}$ by dividing both the numerator and denominator by 2:

$$620 = 310 \frac{6}{20} = \frac{3}{10}.$$

4. Dividing Fractions

Problem: $37 \div 25 \frac{3}{7} \div \frac{2}{5}$

Solution:

- To divide by a fraction, multiply by the reciprocal:

$$37 \times 52 = 3 \times 57 \times 2 = 1514 \frac{3}{7} \times \frac{5}{2}$$

$$= \frac{3 \times 5}{7 \times 2} = \frac{15}{14}.$$
- The result is an improper fraction, which is already in its simplest form.

5. Simplifying Fractions

Problem: Simplify $1216 \frac{12}{16}$.

Solution:

- Find the greatest common divisor (GCD) of 12 and 16, which is 4.
- Divide both the numerator and denominator by 4:

$$1216 = 12 \div 4 \quad 16 \div 4 = 34 \frac{12}{16}$$

$$= \frac{12 \div 4}{16 \div 4} = \frac{3}{4}.$$

6. Adding Mixed Numbers

Problem: $214 + 3232 \frac{1}{4} + 3 \frac{2}{3}$

Solution:

- Convert mixed numbers to improper fractions: $214 = 942 \frac{1}{4} = \frac{9}{4}$ and $323 = 1133 \frac{2}{3} = \frac{11}{3}.$
- Find a common denominator (LCM of 4 and 3 is 12).
 - Convert $94 \frac{9}{4}$ to $2712 \frac{27}{12}$ and $113 \frac{11}{3}$ to $4412 \frac{44}{12}.$
- Now, add the fractions:

$$2712 + 4412 = 7112 \frac{27}{12} + \frac{44}{12} = \frac{71}{12}.$$
- Convert the improper fraction back to a mixed number:

$$7112 = 51112 \frac{71}{12} = 5 \frac{11}{12}.$$

7. Subtracting Mixed Numbers

Problem: $435 - 2234 \frac{3}{5} - 2 \frac{2}{3}$

Solution:

- Convert mixed numbers to improper fractions: $435 = 2354 \frac{3}{5} = \frac{23}{5}$ and $223 = 832 \frac{2}{3} = \frac{8}{3}.$
- Find a common denominator (LCM of 5 and 3 is 15).
 - Convert $235 \frac{23}{5}$ to $6915 \frac{69}{15}$ and $83 \frac{8}{3}$ to $4015 \frac{40}{15}.$
- Now, subtract the fractions:

$$6915 - 4015 = 2915 \frac{69}{15} - \frac{40}{15} = \frac{29}{15}.$$
- Convert the improper fraction back to a mixed number:

$$2915 = 11415 \frac{29}{15} = 1 \frac{14}{15}.$$

8. Multiplying a Fraction by a Whole Number

Problem: $5 \times 385 \times \frac{3}{8}$

Solution:

- Multiply the whole number by the numerator of the fraction:

$$5 \times 38 = 1585 \times \frac{3}{8} = \frac{15}{8}.$$

- The result is an improper fraction, which is $1781\frac{7}{8}$ as a mixed number.

9. Dividing a Fraction by a Whole Number

Problem: $710 \div 2\frac{7}{10} \div 2$

Solution:

- To divide by a whole number, multiply by its reciprocal:

$$710 \times 12 = 720 \frac{7}{10} \times \frac{1}{2} = \frac{7}{20}.$$

10. Converting a Fraction to a Decimal

Problem: Convert $78\frac{7}{8}$ to a decimal.

Solution:

- Divide the numerator by the denominator:
 $7 \div 8 = 0.8757 \div 8 = 0.875.$

decimals

1. Adding Decimals

Problem: $3.45 + 6.783 + 6.78$

Solution:

- Line up the decimal points: $3.453.45 \setminus \setminus$
- $6.78 \setminus \hline 10.23 \setminus$
- The sum is 10.2310.23.

2. Subtracting Decimals

Problem: $9.56 - 4.329.56 - 4.32$

Solution:

- Line up the decimal points: $9.569.56 \setminus \setminus$
- $4.32 \setminus \hline 5.24 \setminus$
- The difference is 5.245.24.

3. Multiplying Decimals

Problem: $2.5 \times 3.62.5 \times 3.6$

Solution:

- Multiply the numbers as if they were integers:
 $25 \times 36 = 90025 \times 36 = 900.$
- Count the total number of decimal places (1 from 2.5 and 1 from 3.6), so the result is 9.009.00.
- The product is 9.09.0.

4. Dividing Decimals

Problem: $7.2 \div 1.27.2 \div 1.2$

Solution:

- Divide as if the numbers were integers:
 $72 \div 12 = 672 \div 12 = 6.$
- The result is 6.06.0.

5. Converting a Decimal to a Fraction

Problem: Convert 0.750.75 to a fraction.

Solution:

- Write 0.750.75 as $75100\frac{75}{100}.$
- Simplify $75100\frac{75}{100}$ by dividing both the numerator and denominator by 25:
 $75100 = 34\frac{75}{100} = \frac{3}{4}.$
- The fraction is $34\frac{3}{4}.$

6. Converting a Fraction to a Decimal

Problem: Convert $7\frac{7}{8}$ to a decimal.

Solution:

- Divide 7 by 8:
 $7 \div 8 = 0.8757 \div 8 = 0.875$.
- The decimal is 0.8750.875.

7. Rounding Decimals

Problem: Round 3.141593.14159 to two decimal places.

Solution:

- The number is 3.141593.14159. Look at the third decimal place (which is 1).
- Since 1 is less than 5, keep the second decimal place as it is.
- The rounded number is 3.143.14.

8. Comparing Decimals

Problem: Which is greater, 0.650.65 or 0.5060.506?

Solution:

- Compare the numbers digit by digit:
 $0.65 > 0.5060.65 > 0.506$.
- So, 0.650.65 is greater.

9. Adding Decimals with Different Decimal Places

Problem: $12.3 + 4.567$

Solution:

- Line up the decimal points:
$$\begin{array}{r} 12.300 \\ 4.567 \\ \hline 16.867 \end{array}$$

- The sum is 16.86716.867.

10. Subtracting Decimals with Different Decimal Places

Problem: $15.678 - 8.415$

Solution:

- Line up the decimal points, and add a zero to 8.4 to make it
$$\begin{array}{r} 15.678 \\ - 8.400 \\ \hline 7.278 \end{array}$$
- The difference is 7.278.

division,

1. Simple Division of Integers

Problem: $84 \div 7$

Solution:

- Divide 84 by 7:
 $84 \div 7 = 12$

2. Division with Decimal Result

Problem: $50 \div 6$

Solution:

- Divide 50 by 6:
 $50 \div 6 = 8.3333 \dots$ (repeating).
- The result is approximately 8.3333.

3. Division of Fractions

Problem: $23 \div 45\frac{2}{3} \div \frac{4}{5}$

Solution:

- To divide by a fraction, multiply by the reciprocal:

$$23 \times 54 = 1012 \frac{2}{3} \times \frac{5}{4} = \frac{10}{12}.$$

- Simplify $1012 \frac{10}{12}$ by dividing both the numerator and denominator by 2:

$$1012 = 56 \frac{10}{12} = \frac{5}{6}.$$

4. Long Division with Larger Numbers

Problem: $1845 \div 15$ $1845 \div 15$

Solution:

- Divide 1845 by 15 using long division:
 $1845 \div 15 = 123$ $1845 \div 15 = 123$
- The quotient is 123123.

5. Dividing Decimals

Problem: $3.6 \div 1.2$ $3.6 \div 1.2$

Solution:

- Divide as if the numbers were integers:
 $36 \div 12 = 3$ $36 \div 12 = 3$.
- The result is 3.03.0.

6. Division with Remainder

Problem: $27 \div 4$ $27 \div 4$

Solution:

- Divide 27 by 4:
 $27 \div 4 = 6$ $27 \div 4 = 6$ with a remainder of 3.
- The result is 6 R36 R3, or $6346 \frac{3}{4}$ as a mixed number.

7. Dividing Large Numbers

Problem: $4872 \div 24$ $4872 \div 24$

Solution:

- Divide 4872 by 24 using long division:
 $4872 \div 24 = 203$ $4872 \div 24 = 203$
- The quotient is 203203.

8. Dividing by a Whole Number

Problem: $540 \div 18$ $540 \div 18$

Solution:

- Divide 540 by 18:
 $540 \div 18 = 30$ $540 \div 18 = 30$.

9. Dividing a Decimal by a Whole Number

Problem: $9.6 \div 4$ $9.6 \div 4$

Solution:

- Divide 9.6 by 4:
 $9.6 \div 4 = 2.4$ $9.6 \div 4 = 2.4$.

10. Dividing Fractions

Problem: $58 \div 23 \frac{5}{8} \div \frac{2}{3}$

Solution:

- To divide by a fraction, multiply by the reciprocal:
 $58 \times 32 = 1516$ $\frac{5}{8} \times \frac{3}{2} = \frac{15}{16}$.
- The result is $1516 \frac{15}{16}$.

multiplication of fractions

1. Simple Multiplication of Fractions

Problem: $25 \times 37\frac{2}{5} \times \frac{3}{7}$

Solution:

- Multiply the numerators: $2 \times 3 = 62 \times 3 = 6$.
- Multiply the denominators: $5 \times 7 = 355 \times 7 = 35$.
- The product is $635\frac{6}{35}$.

2. Multiplying Fractions with Simplification

Problem: $49 \times 38\frac{4}{9} \times \frac{3}{8}$

Solution:

- Multiply the numerators: $4 \times 3 = 124 \times 3 = 12$.
- Multiply the denominators: $9 \times 8 = 729 \times 8 = 72$.
- Simplify $1272\frac{12}{72}$ by dividing both the numerator and denominator by 12:

$$1272 = 16\frac{12}{72} = \frac{1}{6}.$$

3. Multiplying Mixed Numbers

Problem: $112 \times 2231\frac{1}{2} \times 2\frac{2}{3}$

Solution:

- Convert mixed numbers to improper fractions:
 - $112 = 321\frac{1}{2} = \frac{3}{2}$
 - $223 = 832\frac{2}{3} = \frac{8}{3}$
- Multiply the fractions:

$$32 \times 83 = 246 = 4\frac{3}{2} \times \frac{8}{3} = \frac{24}{6} = 4.$$

4. Multiplying Fractions with Larger Numbers

Problem: $58 \times 712\frac{5}{8} \times \frac{7}{12}$

Solution:

- Multiply the numerators: $5 \times 7 = 355 \times 7 = 35$.
- Multiply the denominators: $8 \times 12 = 968 \times 12 = 96$.
- The product is $3596\frac{35}{96}$ (already in simplest form).

5. Multiplying Fractions by Whole Numbers

Problem: $5 \times 345 \times \frac{3}{4}$

Solution:

- Multiply the whole number by the numerator:

$$5 \times 34 = 1545 \times \frac{3}{4} = \frac{15}{4}.$$

6. Multiplying Fractions by a Fraction Greater Than One

Problem: $23 \times 75\frac{2}{3} \times \frac{7}{5}$

Solution:

- Multiply the numerators: $2 \times 7 = 142 \times 7 = 14$.
- Multiply the denominators: $3 \times 5 = 153 \times 5 = 15$.
- The product is $1415\frac{14}{15}$.

7. Multiplying Fractions and Reducing

Problem: $67 \times 145\frac{6}{7} \times \frac{14}{5}$

Solution:

- Multiply the numerators: $6 \times 14 = 84$.
- Multiply the denominators: $7 \times 5 = 35$.
- Simplify $84 \frac{84}{35}$ by dividing both the numerator and denominator by 7:

$$84 \frac{84}{35} = 125 \frac{84}{35} = \frac{12}{5}.$$

8. Multiplying Fractions with a Decimal Result

Problem: $14 \times 35 \frac{1}{4} \times \frac{3}{5}$

Solution:

- Multiply the numerators: $1 \times 3 = 3$.
- Multiply the denominators: $4 \times 5 = 20$.
- The product is $320 \frac{3}{20}$.

9. Multiplying Fractions and Simplifying Before Multiplication

Problem: $38 \times 49 \frac{3}{8} \times \frac{4}{9}$

Solution:

- Simplify before multiplying by canceling common factors.
 - $38 \frac{3}{8}$ and $49 \frac{4}{9}$ have no common factors, so proceed with multiplication.
- Multiply the numerators: $3 \times 4 = 12$.
- Multiply the denominators: $8 \times 9 = 72$.
- The product is $1272 \frac{12}{72}$.
- Simplify $1272 \frac{12}{72}$ by dividing both the numerator and denominator by 12:

$$1272 = 16 \frac{12}{72} = \frac{1}{6}.$$

10. Multiplying Mixed Numbers

Problem: $314 \times 1123 \frac{1}{4} \times 1 \frac{1}{2}$

Solution:

- Convert mixed numbers to improper fractions:
 - $314 = 1343 \frac{1}{4} = \frac{13}{4}$
 - $112 = 321 \frac{1}{2} = \frac{3}{2}$
- Multiply the fractions:

$$134 \times 32 = 398 \frac{13}{4} \times \frac{3}{2} = \frac{39}{8}.$$
- Convert $398 \frac{39}{8}$ to a mixed number:

$$398 = 478 \frac{39}{8} = 4 \frac{7}{8}.$$

SQUARE ROOTS

squaring numbers

1. Square of a Single Digit Number

Problem: 626^2

Solution:

- $62 = 6 \times 6 = 36$

2. Square of a Two-Digit Number

Problem: 12212^2

Solution:

- $122 = 12 \times 12 = 144$

3. Square of a Larger Two-Digit Number

Problem: 25225^2

Solution:

- $252 = 25 \times 25 = 625$
 $252^2 = 25 \times 25 = 625$.

4. Square of a Decimal Number

Problem: $3.523.5^2$

Solution:

- $3.52 = 3.5 \times 3.5 = 12.25$
 $3.5 \times 3.5 = 12.25$.

5. Square of a Negative Number

Problem: $(-4)2(-4)^2$

Solution:

- $(-4)2 = (-4) \times (-4) = 16$
 $(-4)^2 = (-4) \times (-4) = 16$.

6. Square of a Three-Digit Number

Problem: 1002100^2

Solution:

- $1002 = 100 \times 100 = 10,000$
 $100 \times 100 = 10,000$.

7. Square of a Fraction

Problem: $(23)2\left(\frac{2}{3}\right)^2$

Solution:

- $(23)2 = 23 \times 23 = 49$
 $\left(\frac{2}{3}\right)^2 = \frac{2}{3} \times \frac{2}{3} = \frac{4}{9}$.

8. Square of a Mixed Number

Problem: $21222\frac{1}{2}$

Solution:

- Convert to an improper fraction:
 $212 = 522\frac{1}{2} = \frac{5}{2}$.

- Now square it:

$$(52)2 = 254\left(\frac{5}{2}\right)^2 = \frac{25}{4}.$$

9. Square of a Decimal with Multiple Decimal Places

Problem: $1.2521.25^2$

Solution:

- $1.252 = 1.25 \times 1.25 = 1.5625$
 $1.25 \times 1.25 = 1.5625$.

10. Square of a Larger Negative Number

Problem: $(-15)2(-15)^2$

Solution:

- $(-15)2 = (-15) \times (-15) = 225$
 $(-15)^2 = (-15) \times (-15) = 225$.

square roots

1. Square Root of a Single Digit Number

Problem: $64\sqrt{64}$

Solution:

- $64 = 8\sqrt{64} = 8$.

2. Square Root of a Two-Digit Number

Problem: $49\sqrt{49}$

Solution:

- $49 = 7\sqrt{49} = 7.$
-

3. Square Root of a Larger Two-Digit Number

Problem: $121\sqrt{121}$

Solution:

- $121 = 11\sqrt{121} = 11.$
-

4. Square Root of a Decimal Number

Problem: $16.0\sqrt{16.0}$

Solution:

- $16.0 = 4\sqrt{16.0} = 4.$
-

5. Square Root of a Large Number

Problem: $10000\sqrt{10000}$

Solution:

- $10000 = 100\sqrt{10000} = 100.$
-

6. Square Root of a Non-Perfect Square

Problem: $50\sqrt{50}$

Solution:

- $50 \approx 7.071\sqrt{50} \approx 7.071$ (approximate to three decimal places).
-

7. Square Root of a Fraction

Problem: $2536\sqrt{\frac{25}{36}}$

Solution:

- $2536 = 2536 = 56\sqrt{\frac{25}{36}} = \frac{\sqrt{25}}{\sqrt{36}} = \frac{5}{6}.$
-

8. Square Root of a Large Decimal

Problem: $2.25\sqrt{2.25}$

Solution:

- $2.25 = 1.5\sqrt{2.25} = 1.5.$
-

9. Square Root of a Negative Number (Imaginary Number)

Problem: $-16\sqrt{-16}$

Solution:

- $-16 = 4i\sqrt{-16} = 4i$, where i is the imaginary unit.
-

10. Square Root of a Mixed Number

Problem: $414\sqrt{4\frac{1}{4}}$

Solution:

- Convert to an improper fraction:
 $414 = 1744\frac{1}{4} = \frac{17}{4}.$
 - Now take the square root:
 $174 = 174 = 172 \approx 4.1232 \approx$
 $2.061\sqrt{\frac{17}{4}} = \frac{\sqrt{17}}{\sqrt{4}} = \frac{\sqrt{17}}{2} \approx \frac{4.123}{2} \approx 2.061.$
-

square roots (denoted by the root symbol

1. Square Root of a Single Digit Number

Problem: $81\sqrt{81}$

Solution:

- $81 = 9\sqrt{81} = 9.$
-

2. Square Root of a Two-Digit Number

Problem: $36\sqrt{36}$

Solution:

- $36 = 6\sqrt{36} = 6.$
-

3. Square Root of a Larger Two-Digit Number

Problem: $144\sqrt{144}$

Solution:

- $144 = 12\sqrt{144} = 12.$
-

4. Square Root of a Decimal Number

Problem: $0.25\sqrt{0.25}$

Solution:

- $0.25 = 0.5\sqrt{0.25} = 0.5.$
-

5. Square Root of a Large Number

Problem: $2500\sqrt{2500}$

Solution:

- $2500 = 50\sqrt{2500} = 50.$
-

6. Square Root of a Non-Perfect Square

Problem: $18\sqrt{18}$

Solution:

- $18 \approx 4.242\sqrt{18} \approx 4.242$ (approximate to three decimal places).
-

7. Square Root of a Fraction

Problem: $1625\sqrt{\frac{16}{25}}$

Solution:

- $1625 = 1625 = 45\sqrt{\frac{16}{25}} = \frac{\sqrt{16}}{\sqrt{25}} = \frac{4}{5}.$
-

8. Square Root of a Large Decimal

Problem: $3.61\sqrt{3.61}$

Solution:

- $3.61 = 1.9\sqrt{3.61} = 1.9.$
-

9. Square Root of a Negative Number (Imaginary Root)

Problem: $-25\sqrt{-25}$

Solution:

- $-25 = 5i\sqrt{-25} = 5i$, where i is the imaginary unit.
-

10. Square Root of a Mixed Number

Problem: $914\sqrt{9\frac{1}{4}}$

Solution:

- Convert the mixed number to an improper fraction:

$$914 = 3749\frac{1}{4} = \frac{37}{4}.$$

- Now, take the square root:

$$374 = 372 \approx 6.082 = 3.04 \sqrt{\frac{37}{4}} = \frac{\sqrt{37}}{2} \\ \approx \frac{6.08}{2} = 3.04.$$

GRAPH

Drawing graphs is a fundamental way of visually representing data in various fields such as mathematics, economics, science, and engineering. Graphs provide an intuitive way to understand trends, relationships, and distributions. Below are **10 numerical problems** that demonstrate how to draw different types of graphs, such as line graphs, bar graphs, scatter plots, histograms, and pie charts. These examples show the process of creating graphs, the type of data used, and their interpretations.

1. Line Graph: Temperature vs. Time

- **Data:**
 - Time (hours): 1, 2, 3, 4, 5
 - Temperature (°C): 20, 22, 24, 26, 28
- **Process:**
 - Plot time on the x-axis and temperature on the y-axis.
 - Mark the points (1, 20), (2, 22), (3, 24), (4, 26), and (5, 28).
 - Connect the points to show how temperature increases over time.

2. Bar Graph: Sales Data

- **Data:**
 - Categories: A, B, C, D, E
 - Sales (units): 15, 30, 45, 60, 75
- **Process:**
 - Label the x-axis with categories A to E.

- Draw bars of height corresponding to the sales values (15, 30, 45, 60, 75).
- The bar heights represent sales in units.

3. Pie Chart: Market Share

- **Data:**
 - Company A: 25%
 - Company B: 35%
 - Company C: 40%
- **Process:**
 - Draw a circle and divide it into three sectors based on the market share percentages.
 - Company A's sector should cover 25% of the circle, Company B's 35%, and Company C's 40%.

4. Scatter Plot: Height vs. Weight

- **Data:**
 - Heights (cm): 150, 160, 170, 180, 190
 - Weights (kg): 45, 55, 65, 75, 85
- **Process:**
 - Plot each pair of height and weight values on the graph.
 - Mark points at (150, 45), (160, 55), (170, 65), (180, 75), and (190, 85).
 - Scatter plots help reveal correlations, such as a positive correlation between height and weight.

5. Histogram: Age Distribution

- **Data:**
 - Age Ranges: 10-20, 21-30, 31-40
 - Frequency: 5, 10, 15
- **Process:**
 - Plot age ranges on the x-axis and frequency on the y-axis.
 - Create bars for each age range, with heights representing the frequency.
 - The histogram shows the distribution of data across age ranges.

6. Line Graph: Profit vs. Months

- **Data:**
 - Months: January, February, March, April, May
 - Profit (USD): 1000, 2000, 1500, 2500, 3000
- **Process:**
 - Plot months on the x-axis and profit on the y-axis.
 - Mark the points (January, 1000), (February, 2000), (March, 1500), (April, 2500), (May, 3000).
 - Connect the points to show the trend in profits over the months.

7. Bar Graph: Student Scores

- **Data:**
 - Students: Alice, Bob, Charlie, David, Eve
 - Scores: 85, 90, 80, 75, 95
- **Process:**
 - Label the x-axis with student names.
 - Draw bars for each student, where the height represents their score.
 - The graph helps compare individual performance.

8. Scatter Plot: Hours Studied vs. Test Scores

- **Data:**
 - Hours studied: 1, 2, 3, 4, 5
 - Test scores: 50, 60, 70, 80, 90
- **Process:**
 - Plot each pair of hours studied and corresponding test score.
 - The scatter plot will show a positive relationship, indicating that as study time increases, test scores also improve.

9. Pie Chart: Budget Allocation

- **Data:**
 - Rent: 40%
 - Food: 20%
 - Utilities: 15%
 - Savings: 25%
- **Process:**
 - Draw a circle and divide it into four sections based on the percentage allocation.

- Each section represents a portion of the total budget, visually showing how resources are distributed.

10. Histogram: Exam Results Distribution

- **Data:**
 - Score Ranges: 0-10, 11-20, 21-30, 31-40, 41-50
 - Number of Students: 3, 7, 5, 8, 2
- **Process:**
 - Label the x-axis with score ranges and the y-axis with the number of students.
 - Draw bars representing the number of students in each score range.
 - The histogram provides insight into the performance distribution of students.

Summary of Graph Types and Their Usage:

Graph Type	Data Representation
Line Graph	Used for trends over time, such as temperature or profit.
Bar Graph	Used for comparing quantities across different categories, like sales or student scores.
Pie Chart	Used for showing proportions of a whole, such as market share or budget allocation.
Scatter Plot	Used to show relationships between two variables, such as height and weight.
Histogram	Used to display the frequency distribution of data, like age or exam scores.

Drawing graphs is an essential skill for representing and interpreting data visually. It allows easy analysis and comparison of different sets of information, helping to identify trends, correlations, and patterns effectively.

simple equations, along with instructions for drawing their graphs.

1. Equation: $y=2x+1$ $y = 2x + 1$

- **Steps:**

- Choose values for x (e.g., $x=-2, -1, 0, 1, 2$).
- Calculate corresponding values for y .
 - $For x = -2, y = 2(-2) + 1 = -3$
 - $For x = -1, y = 2(-1) + 1 = -1$
 - $For x = 0, y = 2(0) + 1 = 1$
 - $For x = 1, y = 2(1) + 1 = 3$
 - $For x = 2, y = 2(2) + 1 = 5$
- Plot points $(-2, -3), (-1, -1), (0, 1), (1, 3), (2, 5)$ and draw a straight line.

2. Equation: $y=-x+4$ $y = -x + 4$

- **Steps:**

- Choose values for x (e.g., $x=-2, -1, 0, 1, 2$).
- Calculate corresponding values for y .
 - $For x = -2, y = -(-2) + 4 = 6$
 - $For x = -1, y = -(-1) + 4 = 5$
 - $For x = 0, y = -(0) + 4 = 4$

- $For x = 1, y = -(1) + 4 = 3$
- $For x = 2, y = -(2) + 4 = 2$

- Plot points $(-2, 6), (-1, 5), (0, 4), (1, 3), (2, 2)$ and draw a straight line.

3. Equation: $y=3x-2$ $y = 3x - 2$

- **Steps:**

- Choose values for x (e.g., $x=-2, -1, 0, 1, 2$).
- Calculate corresponding values for y .
 - $For x = -2, y = 3(-2) - 2 = -8$
 - $For x = -1, y = 3(-1) - 2 = -5$
 - $For x = 0, y = 3(0) - 2 = -2$
 - $For x = 1, y = 3(1) - 2 = 1$
 - $For x = 2, y = 3(2) - 2 = 4$
- Plot points $(-2, -8), (-1, -5), (0, -2), (1, 1), (2, 4)$ and draw a straight line.

4. Equation: $y=4$ $y = 4$

- **Steps:**

- The equation represents a horizontal line.
- Choose values for x (e.g., $x=-2, -1, 0, 1, 2$).
- For all values of x , $y=4$.
- Plot points $(-2, 4), (-1, 4), (0, 4), (1, 4), (2, 4)$ and draw a horizontal line.

5. Equation: $x=3x = 3$

- **Steps:**
 - The equation represents a vertical line.
 - Choose values for yy (e.g., $y=-2,-1,0,1,2$).
 - For all values of yy , $x=3x = 3$.
 - Plot points $(3,-2),(3,-1),(3,0),(3,1),(3,2)$ and draw a vertical line.

- For $x = 1x = 1, y = 2(1) = 2y = 2(1) = 2$
- For $x = 2x = 2, y = 2(2) = 4y = 2(2) = 4$
- Plot points $(-2,-4), (-1,-2), (0,0), (1,2)$ and draw a straight line.

6. Equation: $y=x^2y = x^2$

- **Steps:**
 - Choose values for xx (e.g., $x=-2,-1,0,1,2$).
 - Calculate corresponding values for yy .
 - For $x = -2x = -2, y = (-2)^2 = 4y = (-2)^2 = 4$
 - For $x = -1x = -1, y = (-1)^2 = 1y = (-1)^2 = 1$
 - For $x = 0x = 0, y = (0)^2 = 0y = (0)^2 = 0$
 - For $x = 1x = 1, y = (1)^2 = 1y = (1)^2 = 1$
 - For $x = 2x = 2, y = (2)^2 = 4y = (2)^2 = 4$
 - Plot points $(-2,4), (-1,1), (0,0), (1,1), (2,4)$ and draw a parabola.

8. Equation: $y=-3x+6y = -3x + 6$

- **Steps:**
 - Choose values for xx (e.g., $x=-2,-1,0,1,2$).
 - Calculate corresponding values for yy .
 - For $x = -2x = -2, y = -3(-2) + 6 = 12y = -3(-2) + 6 = 12$
 - For $x = -1x = -1, y = -3(-1) + 6 = 9y = -3(-1) + 6 = 9$
 - For $x = 0x = 0, y = -3(0) + 6 = 6y = -3(0) + 6 = 6$
 - For $x = 1x = 1, y = -3(1) + 6 = 3y = -3(1) + 6 = 3$
 - For $x = 2x = 2, y = -3(2) + 6 = 0y = -3(2) + 6 = 0$
 - Plot points $(-2,12), (-1,9), (0,6), (1,3), (2,0)$ and draw a straight line.

7. Equation: $y=2xy = 2x$

- **Steps:**
 - Choose values for xx (e.g., $x=-2,-1,0,1,2$).
 - Calculate corresponding values for yy .
 - For $x = -2x = -2, y = 2(-2) = -4y = 2(-2) = -4$
 - For $x = -1x = -1, y = 2(-1) = -2y = 2(-1) = -2$
 - For $x = 0x = 0, y = 2(0) = 0y = 2(0) = 0$

9. Equation: $y=-x^2+4y = -x^2 + 4$

- **Steps:**
 - Choose values for xx (e.g., $x=-2,-1,0,1,2$).
 - Calculate corresponding values for yy .
 - For $x = -2x = -2, y = -(-2)^2 + 4 = -4y = -(-2)^2 + 4 = -4$
 - For $x = -1x = -1, y = -(-1)^2 + 4 = 3y = -(-1)^2 + 4 = 3$
 - For $x = 0x = 0, y = -(0)^2 + 4 = 4y = -(0)^2 + 4 = 4$

- For $x = 1, y = - (1)^2 + 4 = 3$
- For $x = 2, y = - (2)^2 + 4 = -4$
- Plot points $(-2, -4), (-1, 3), (0, 4), (1, 3), (2, -4)$ and draw a downward-opening parabola.

10. Equation: $y = 5$

- **Steps:**
 - The equation represents a horizontal line at $y = 5$.
 - Choose values for x (e.g., $x = -2, -1, 0, 1, 2$).
 - For all values of x , $y = 5$.
 - Plot points $(-2, 5), (-1, 5), (0, 5), (1, 5), (2, 5)$ and draw a horizontal line.

Summary of Graphing Instructions:

For each equation, you:

1. Choose several values of x .
2. Calculate the corresponding values of y .
3. Plot these points on a coordinate plane.
4. Draw a straight line, parabola, or horizontal/vertical line as appropriate.

By plotting these equations, you create a visual representation of how the values of x and y interact, revealing trends and relationships clearly.

compound equations

1. System of Linear Equations:

$$y = 2x + 1 \text{ and } y = -x + 4$$

- **Steps:**
 - **Solve the system** by finding the point of intersection.
 - Set the equations equal to each other: $2x + 1 = -x + 4 \Rightarrow 3x = 3 \Rightarrow x = 1$
 - Substitute $x = 1$ into one of the equations: $y = 2(1) + 1 = 3$
 - The point of intersection is $(1, 3)$.
 - **Graphing:** Plot both lines and mark the point $(1, 3)$ as their intersection.

2. System of Linear Equations:

$$y = 3x - 2 \text{ and } y = -x + 4$$

- **Steps:**
 - **Solve the system:** $3x - 2 = -x + 4 \Rightarrow 4x = 6 \Rightarrow x = 1.5$
 - Substitute $x = 1.5$ into one equation: $y = 3(1.5) - 2 = 2.5$
 - The point of intersection is $(1.5, 2.5)$.
 - **Graphing:** Plot both lines and mark the intersection at $(1.5, 2.5)$.

3. System of Linear Equations:

$$y = x + 2 \text{ and } y = -x + 6$$

- **Steps:**
 - **Solve the system:** $x + 2 = -x + 6 \Rightarrow 2x = 4 \Rightarrow x = 2$
 - Substitute $x = 2$ into one equation: $y = 2 + 2 = 4$
 - The point of intersection is $(2, 4)$.
 - **Graphing:** Plot both lines and mark the intersection at $(2, 4)$.